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(54) **Surgical cassette**

Chirugische Kassette

Cassette chirurgicale

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EP-A- 0 320 168
US-A- 5 246 422
US-A- 5 460 490
WO-A-95/28190
US-A- 5 267 956

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Description

Background of the Invention

[0001] The present invention relates to surgical cassettes and more particularly to an identification system for surgical cassettes.

[0002] The use of cassettes with surgical instruments to help manage irrigation and aspiration flows into a surgical site are well-known. U.S. Patent Nos. 4,493,695, 4,627,833 (Cook), 4,395,258 (Wang, et al.), 4,713,051 (Steppe, et al.), 4,798,850 (DeMeo, et al.), 4,758,238, 4,790,816 (Sundblom, et al.) and 5,267,956, 5,364,342 (Beuchat) all disclose tubeless or tube-type surgical cassettes.

These cassettes may be adapted for use in the present invention.

[0003] The fluidic performance of the surgical instrument is substantially affected by the fluidic performance of the cassette. As a result, prior art surgical instruments and cassettes are designed to work as an integral system, with the fluidic performance of the cassette designed to optimize the fluidic performance of the entire surgical system. This integral design concept has required that prior art surgical instruments be used with only one specific cassette, and that any given cassette interacts with only one type of surgical instrument.

[0004] With the advances made in the last few years in digital circuitry, it is desirable to design and build surgical instruments that can manually or automatically change the surgical operating parameters to suit special situations or a surgeon's specific operating preferences. Parameters such as aspiration fluid flow rate, pump speed, vacuum level, irrigation fluid pressure and irrigation fluid flow rate can be preprogrammed for a specific surgeon or surgical procedure. This increased flexibility of modern surgical instruments is somewhat limited by the inflexibility of the surgical cassette. In order to optimize the surgical system, the performance of the cassette should be optimized for the specific surgical procedure or the specific set of parameters being used by the surgeon. While a cassette with adjustable fluidics performance is one alternative, the most cost effective method of optimizing cassette performance, particularly if the cassette is intended to be discarded after a single use, is to design a different cassette for each surgical procedure or set of operating parameters, however; the use of different cassettes requires that the instrument "recognize" the type of cassette being used.

[0005] US-A- 5,267,956 (referred to above) describes a surgical cassette with a one-piece housing, a fluid chamber formed within the housing and a drain bag in fluid communication with the fluid chamber through a peristaltic pump tube. US-A-5,267,956 forms the basis for the preamble to claim 1.

[0006] US-A-5,246, 422 describes a device having a permanent module and a removable cassette which is attachable to the module. The cassette has a coding device which is a stem which protrudes from the cassette. The stem engages in one of a series of grooves in the module. Each groove corresponds to a contact which select the program appropriate for the surgical procedure for which the cassette is designed.

[0007] WO 95/28190 describes a pump for supplying pharmaceuticals etc. to a subject, which is controlled by a module. The fluid is held in a reservoir cassette. As different cassettes may be provided, each cassette is provided with indica which identify the type of cassette to the control module which in turn is provided with indica reading means. Different types of identifying indica and indica reading means are described - for example force sensitive resistors which detect the presence of a cassette by means of detection of pressure applied to the resistor by a projection on the cassette, a microswitch, optical sensors, and optical print sensors.

[0008] US-A-5,460,490 describes an irrigation pump system capable of operating in different modes for various surgical procedures. Individual tubing sets are fitted to the pump for each distinct procedure. The tubing sets are coded so that the appropriate mode of the pump can be identified. One coding method described is use of an arrangement of magnets to identify the tubing set.

Accordingly it is desirable to provide an alternative cassette which may be used with a cassette identification system.

Brief Description of the Invention

[0009] The present invention includes any of a variety of tube-type or tubeless surgical cassettes having a series of break-off tabs that can be optically sensed by the surgical instrument.

[0010] Accordingly, one objective of the present invention is to provide a surgical cassettes having a series of break-off tabs. Another objective of the present invention is to provide a surgical cassette identification system. The surgical cassette of the invention is set forth in claim 1. The surgical identification system of the invention is set forth in claim 4.

[0011] These and other objectives and advantages of the present invention will become apparent from the detailed description and claims which follow.

Brief Description of the Drawings

[0012] FIG. 1 is a top, left-hand perspective view of one embodiment of the present invention.

[0013] FIG. 2 is a bottom, right-hand perspective view of the cassette illustrated in FIG. 1.

[0014] FIG. 3 is a rear, elevational view of the cassette illustrated in FIG. 1.

[0015] FIG. 4 is a left side, elevational view of the cassette illustrated in FIG. 1.

[0016] FIG. 5 is a right side, elevational view of the cassette illustrated in FIG. 1.

[0017] FIG. 6 is a front, elevational view of the cas-

sette illustrated in FIG. 1.

[0018] FIG. 7 is a top, plan view of the cassette illustrated in FIG. 1.

[0019] FIG. 8 is a bottom, plan view of the cassette illustrated in FIG. 1.

[0020] FIG. 9 is an exploded perspective view of the cassette illustrated in FIG. 1 including the drain bag.

[0021] FIG. 10 is a schematic illustration of the optical reading array that may be used with the cassette of Figure 1.

[0022] FIG. 11 is an electrical schematic illustrating one control system suitable for use with the cassette of Figure 1.

[0023] FIG. 12 is a partial cross-sectional view of the cassette receiving portion of a surgical instrument suitable for use with the cassette of Figure 1.

[0024] FIG. 13 is a partial cross-sectional view of the cassette receiving portion of a surgical instrument suitable for use with the cassette of Figure 1 similar to FIG. 12 showing the cassette installed.

[0025] FIG. 14 is an elevational view of a prismatic tab used with the present invention.

[0026] FIG. 15 is a partial cross-sectional view of the cassette receiving portion of a surgical instrument suitable for use with the cassette of Figure 1 and similar to FIG. 13 showing the cassette installed.

Detailed Description of the Invention

[0027] As seen in FIGS. 1-8, cassette 10 of the present invention generally comprises housing 12, drain bag 14, peristaltic pump tube 16 and aspiration lines 18 and 20. Housing 12 may be injection molded plastic and formed in a single piece. Housing 12 may contain handle 44, for assisting in installing and removing cassette 10 in the instrument 11 and may contain vacuum inlet port 46. Drain bag 14 may be made from plastic film and preferably contains one-way valve 22 and sampling port 24. Holes 32 allow drain bag 14 to hang from hooks 26 located on housing 12, so that port 28 connects to output port 30 of peristaltic pump tube 16. Tube 16 and lines 18 and 20 may be made of any suitable material, but silicone rubber is preferred.

[0028] As best seen in FIGS. 1, 2, 3, 5, 7 and 8, associated with housing 12 is cassette identification system 34. In the embodiment illustrated in FIGS. 1, 2, 3, 5, 7 and 8, system 34 consists of a plurality of tabs 36 integrally molded with housing 12. While any number of tabs 36 may be used, three tabs 36 are illustrated. Tabs 36 are formed so as to be easily removed or broken off in a variety of different patterns. In use, when cassette 10 is installed in surgical instrument 11, the pattern of tabs 36 can be read easily by the instrument.

[0029] In an embodiment, as illustrated in FIG. 10, the pattern of tabs 36 is read optically by the use of an array of infrared light emitting diodes ("LEDs") 38 and phototransistors 40. LEDs 38 and phototransistor 40 may be any suitable I.R photodiode/phototransistor pair such as Model Nos. VTE7124 and VTT7122 available from EG&G Vactec Optoelectronics. In use, LEDs 38 emit light that is reflected by tabs 36. The reflection pattern is sensed by phototransistors 40 and correlated to the presence or absence of tabs 36 and, correspondingly, the pattern of tabs 36. By using a unique pattern of tabs 36 for each type of cassette being used, the instrument is able to recognize the type of cassette installed in the instrument.

[0030] To improve the signal to noise ratio, LEDs 38 may be pulsed at a higher current level than that allowed for continuous illumination (*e.g.*, 500 mA versus 50 mA) in order to override any stray background noise levels from sources such as sunlight, room light and other lights within the instrument.

[0031] Preferably LEDs 38 are sequentially cycled on and off by a microcontroller (not shown) to eliminate crosstalk. The width of the LED pulse is a function of the phototransistor turn-on characteristic, which tends to be larger with increasing sense resistor values. The time between adjacent pulses is a function of the turn-off characteristic, which also varies with the sense resistor value, and tends to be longer than the turn-on value.

[0032] As can be seen in FIGS. 12 and 13, in one embodiment of the present invention, surgical instrument 11 contains cassette receiving portion 48 with tab receiving slot 50. Slot 50 is sealed shut by door 52 that pivots about hinge 54. LEDs 38 and phototransistors 40 are mounted on circuit board 56 so as to be located near door 52 by component spacer 57. As seen in FIGS. 10 and 12 when door 52 is closed (indicating that no cassette is installed), signal 58 will be reflected back to phototransistor 40, allowing all LED/phototransistors paths to be tested. As seen in FIG. 13 when cassette 10 is installed in instrument 11, tabs 36 cause door 52 to pivot (approximately 30°) so as to scatter or absorb any light passing through tabs 36.

[0033] As can be seen in FIG. 11, LEDs 38 are illuminated by control signal 60. Light from LED 38 is reflected to phototransistor 40 by door 52 or tab 36. The output of phototransistor 40 varies with the amount of light striking phototransistor 40. At low levels, such as the reflection off of open door 52 (see FIG. 13), the current generated by phototransistor 40 has been found to be around 5 μA. At higher levels, such as the reflection off of tabs 36 or closed door 52 (see FIG. 12), the current generated by phototransistor 40 has been found to be approximately 50 μA. Sense resistor R2 transforms the signal generated by phototransistor 40 into 0.05V and 0.50V, respectively. Voltage comparator 62 compares the transformed signal with a 0.15V reference signal. This process is repeated sequentially for each LED 38.

[0034] As seen in FIGS. 1-9, in use, vacuum is introduced into fluid chamber 64 in cassette 10 through vacuum port 46. Chamber 46 communicates with lines 18 and 20, allowing material to be drawn into chamber 64 through lines 18 and 20. When the material in chamber 64 reaches a certain level, a sensor (not shown) causes

a peristaltic pump roller head (not shown) contained in surgical instrument 11 to rotate within pump tube 16, thereby pumping material out of chamber 64 and into bag 14.

[0035] In an embodiment of the present invention, illustrated in FIGS. 14 and 15 tabs 36' preferably are tapered or prismatic in shape. Preferably, the portion of tabs 36' nearest to housing 12' is of uniform thickness (e.g. 0.23cm/0.090 inches), with the remainder of tabs 36' gradually decreasing in thickness to around 0.025cm (0.010 inches). Tabs 36' preferably are approximately 0.76cm (0.30 inches) long, with approximately one half being of uniform thickness. In this embodiment, LEDs 38' and phototransistors 40' are mounted on circuit board 56' so as to be located on opposite sides of tabs 36'. When tabs 36' are present, the prismatic shape of tabs 36' scatters or deflects the light being emitted by LEDs 38' so that little of the light is detected by phototransistors 40'. When tabs 36' are not present, much of the light being emitted by LEDs 38' is detected by phototransistors 40'. In this way, LEDs 38' and phototransistors 40' can detect the presence of tabs 36'.

[0036] The light emitting diodes are capable of being pulsed on and off sequentially so as to reflect light to corresponding phototransistors.

[0037] This description is given for purposes of illustration and explanation. It will be apparent to those skilled in the relevant art that changes and modifications may be made to the invention described above without departing from the scope of the claims which follow.

Claims

1. A surgical cassette (10), comprising:

   a housing (12,12');
   a fluid chamber formed within the housing (12,12');
   identifying means associated with the housing (12,12');
   a drain bag (14) in fluid communication with the fluid chamber through a peristaltic pump tube (16); **characterised in that** the identifying means comprises a plurality of identifying break-off tabs (36,36') which are formed on the cassette (10) and which may be removed or broken off.

2. A surgical cassette (10) according to claim 1 wherein the tabs (36, 36') are prismatic in shape.

3. A surgical cassette (10) according to claim 2 wherein the portion of the tabs (36, 36') nearest the housing (12,12') is of uniform thickness with the remainder of the tabs (36,36') gradually decreasing in thickness.

4. A surgical cassette identification system (34), comprising:

   a surgical instrument (11) having a cassette receiving portion (48);
   a surgical cassette (10) as defined in claim 1 that is removably installable in the cassette receiving portion (48); and optical detection means for detection of the tabs (36, 36') on the cassette, the optical detecting means being located in the surgical instrument (11) to detect the presence or absence of the cassette (10) and to identify the cassette (10) by means of the tab pattern where a cassette (10) is installed.

5. A surgical cassette identification system (34) according to claim 4 wherein the optical detection means comprises a plurality of light emitting diodes (38,38') near the identifying tabs (36, 36') and a plurality of corresponding phototransistors (40, 40'), the light emitting diodes (38, 38') being capable of being pulsed on and off sequentially, the light being emitted in the direction of the tabs (36, 36') and where light is reflected and/or transmitted by the tabs (36, 36') and/or the cassette receiving portion (48), the light activating said phototransistors (40, 40').

6. A surgical cassette identification system (34) according to claim 5 wherein the cassette receiving portion (48) has a tab (36, 36') receiving slot (50) provided with a door (52) moveable between a closed position across the slot (50) when no cassette (10) is inserted, and an open position away from the slot when the cassette (10) is inserted.

7. A surgical cassette identification system (34) according to claim 6 wherein the door (52) reflects light from a light emitting diode (38, 38') to a phototransistor (40, 40') when the door is in the closed position.

8. A surgical cassette identification system (34) according to claim 7 or claim 8 wherein the door (52) scatters or absorbs light from a light emitting diode (38, 38') when in the open position.

Patentansprüche

1. Chirurgische Kassette (10), die folgendes umfaßt:

   ein Gehäuse (12, 12');
   eine Fluidkammer, die in dem Gehäuse (12, 12') ausgebildet ist;
   Identifizierungsmittel, die dem Gehäuse (12, 12') zugeordnet sind;

einen Abflußbeutel (14), der in Fluidverbindung mit der Fluidkammer durch einen Schlauch einer Peristaltikpumpe (16) steht,

dadurch gekennzeichnet, daß die Identifizierungsmittel eine Mehrzahl von identifizierenden Abbrechstreifen (36, 36') umfassen, die auf der Kassette (10) ausgebildet sind und die entfernt oder abgebrochen werden können.

2. Chirurgische Kassette (10) gemäß Anspruch 1, wobei die Streifen (36, 36') eine Prismenform besitzen.

3. Chirurgische Kassette (10) gemäß Anspruch 2, wobei der dem Gehäuse (12, 12') nächste Abschnitt der Streifen (36, 36') eine einheitliche Dicke besitzt und der Rest der Streifen (36, 36') allmählich in der Dicke abnimmt.

4. Identifikationssystem (34) für eine chirurgische Kassette, das folgendes umfaßt:

ein chirurgisches Instrument (11) mit einem eine Kassette aufnehmenden Abschnitt (48),
eine chirurgische Kassette (10) wie in Anspruch 1 definiert, die entfernbar in dem die Kassette aufnehmenden Abschnitt (48) installierbar ist, und optischen Detektionsrnitteln zur Detektion der Streifen (36, 36') auf der Kassette, wobei die optischen Detektionsmittel in dem chirurgischen Instrument (11) angeordnet sind, um die An- oder Abwesenheit der Kassette (10) zu detektieren und um die Kassette (10) anhand des Musters der Streifen zu identifizieren, wenn eine Kassette (10) installiert ist.

5. Identifikationssystem (34) für eine chirurgische Kassette gemäß Anspruch 4, wobei die optischen Detektionsmittel eine Mehrzahl von Licht emittierenden Dioden (38, 38') nahe den Identifizierungsstreifen (36, 36') und eine Mehrzahl von entsprechenden Phototransistoren (40, 40') umfaßt, wobei die Licht emittierenden Dioden (38, 38') dafür geeignet sind, sequenziell pulsartig ein- und ausgeschaltet zu werden, das Licht in die Richtung der Streifen (36, 36') emittiert wird und, wenn Licht durch die Streifen (36, 36') und/oder durch den die Kassette aufnehmenden Abschnitt (48) reflektiert und/oder transmittiert wird, das Licht die Phototransistoren (40, 40') aktiviert.

6. Identifikationssystem (34) für eine chirurgische Kassette gemäß Anspruch 5, wobei der die Kassette aufnehmende Abschnitt (48) einen einen Streifen (36, 36') aufnehmenden Steckplatz (50) besitzt, der mit einer Tür (52) versehen ist, die zwischen einer geschlossenen Position über dem Steckplatz (50), wenn keine Kassette (10) eingelegt ist, und einer offenen, von dem Steckplatz entfernten Position, wenn die Kassette (10) eingelegt ist, beweglich ist.

7. Identifikationssystem (34) für eine chirurgische Kassette gemäß Anspruch 6, wobei die Tür (52) Licht von einer Licht emittierenden Diode (38, 38') zu einem Phototransistor (40, 40') reflektiert, wenn sich die Tür in der geschlossenen Position befindet.

8. Identifikationssystem (34) einer chirurgischen Kassette gemäß Anspruch 7 oder Anspruch 8, wobei die Tür (52) Licht von einer Licht emittierenden Diode (38, 38') streut oder absorbiert, wenn sie sich in der offenen Position befindet.

Revendications

1. Cassette chirurgicale (10), comportant :

un boîtier (12, 12'),
une chambre de fluide formée à l'intérieur du boîtier (12, 12'),
des moyens d'identification associés au boîtier (12, 12'),
un sachet de drainage (14) en communication fluidique avec la chambre de fluide via un tube (16) d'une pompe péristaltique, **caractérisée en ce que** les moyens d'identification comportent
une pluralité de pattes d'identification cassables (36, 36') qui sont formées sur la cassette (10) et qui peuvent être enlevées ou cassées.

2. Cassette chirurgicale (10) selon la revendication 1, dans laquelle les pattes (36, 36') ont une forme prismatique.

3. Cassette chirurgicale (10) selon la revendication 2, dans laquelle la partie des pattes (36, 36') la plus proche du boîtier (12, 12') possède une épaisseur uniforme, le reste des pattes (36, 36') diminuant graduellement en termes d'épaisseur.

4. Système d'identification de cassette chirurgicale (34), comportant :

un instrument chirurgical (11) ayant une partie de réception de cassette (48),
une cassette chirurgicale (10) telle que définie dans la revendication 1 qui peut être installée d'une manière amovible dans la partie de réception de cassette (48), et des moyens de détection optique pour la détection des pattes (36, 36') sur la cassette, les moyens de détection optique étant positionnés dans l'instrument chirurgical (11) pour détecter la présence ou l'absence de la cassette (10) et identifier la casset-

te (10) par l'intermédiaire du dessin que forment les pattes là où une cassette (10) est installée.

5. Système d'identification de cassette chirurgicale (34) selon la revendication 4, dans lequel les moyens de détection optique comportent une pluralité de diodes électroluminescentes (38, 38') situées à proximité des pattes d'identification (36, 36') et une pluralité de phototransistors (40, 40') correspondants, les diodes électroluminescentes (38, 38') pouvant être activées et désactivées séquentiellement, la lumière étant émise dans l'a direction des pattes (36, 36') et, là où la lumière est réfléchie et/ou transmise par les pattes (36, 36') et/ou la partie de réception de cassette (48), la lumière activant lesdits phototransistors (40, 40').

6. Système d'identification de cassette chirurgicale (34) selon la revendication 5, dans lequel la partie de réception de cassette (48) a une fente (50) de réception de patte (36, 36') munie d'une porte (52) mobile entre une position fermée à travers la fente (50) lorsque aucune cassette (10) n'est insérée, et une position ouverte éloignée de la fente lorsque la cassette (10) est insérée.

7. Système d'identification de cassette chirurgicale (34) selon la revendication 6, dans lequel la porte (52) réfléchit la lumière émise par une diode électroluminescente (38, 38') vers un phototransistor (40, 40') lorsque la porte se trouve dans la position fermée.

8. Système d'identification de cassette chirurgicale (34) selon la revendication 7 ou la revendication 8, dans lequel la porte (52) diffuse ou absorbe la lumière émise par une diode électroluminescente (38, 38') lorsqu'elle se situe dans la position ouverte.

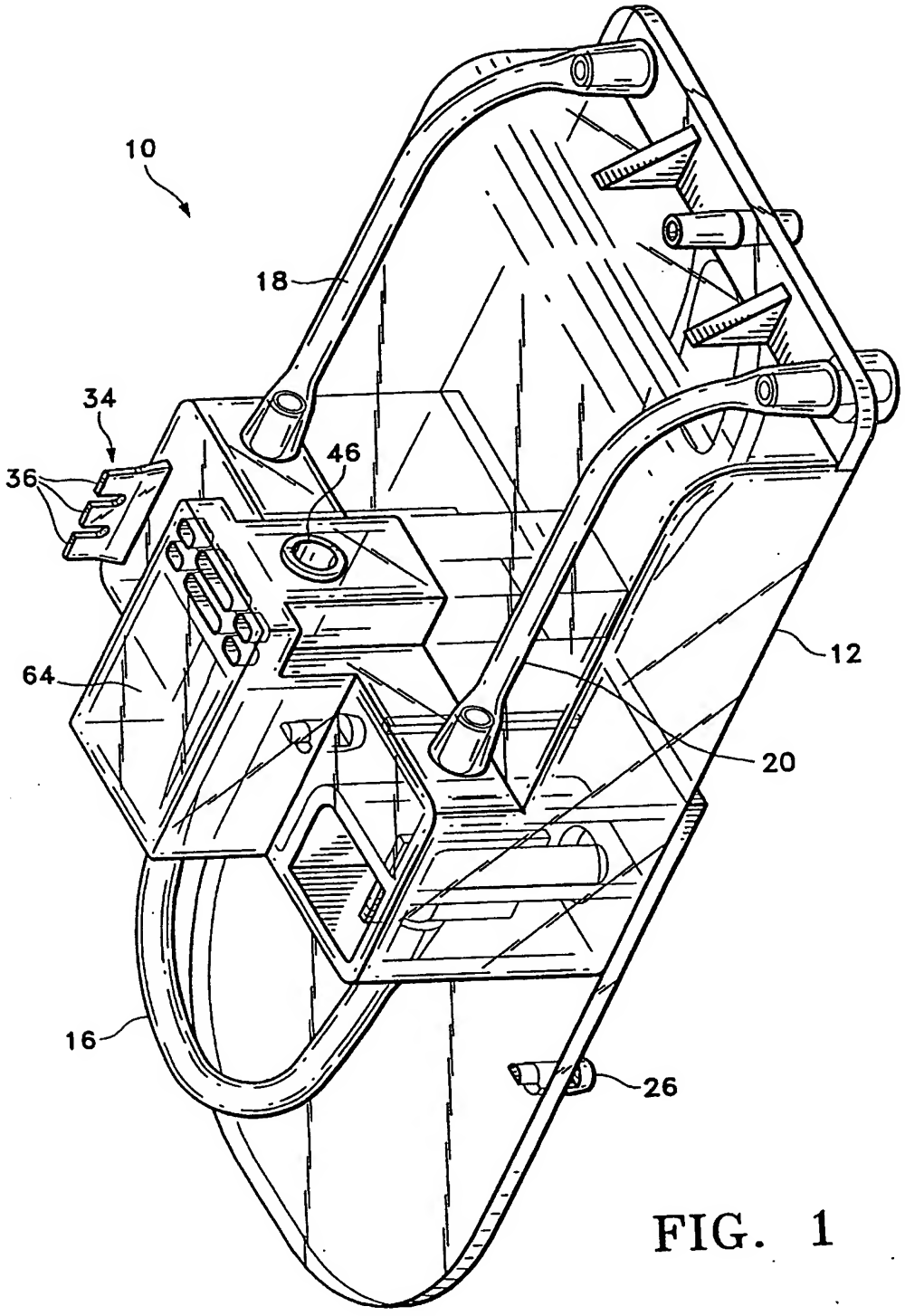

FIG. 1

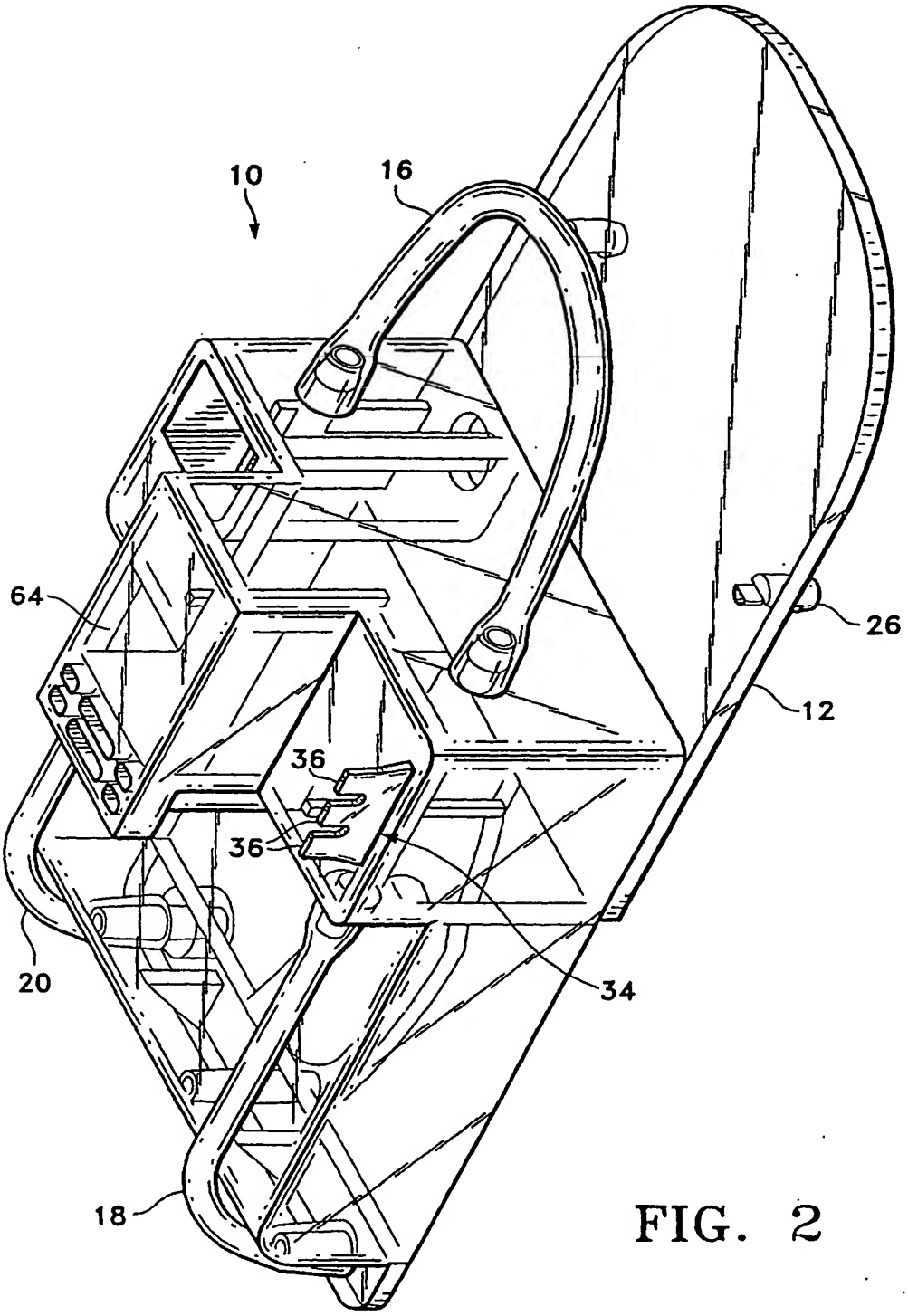

FIG. 2

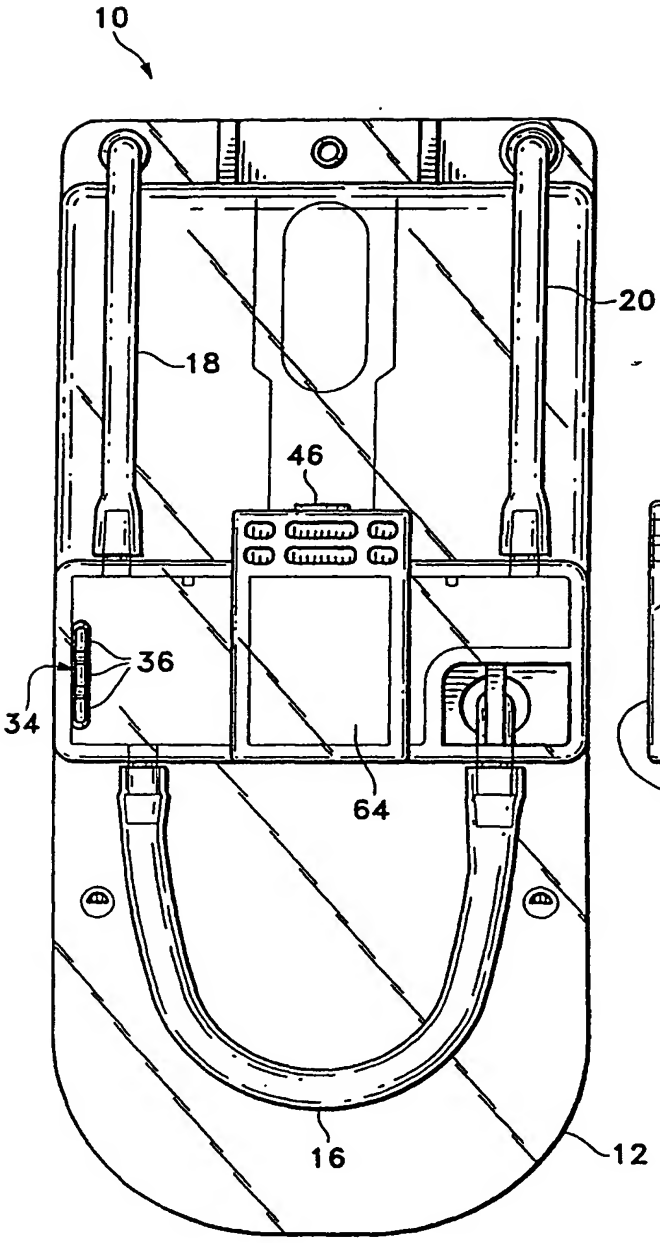

FIG. 3

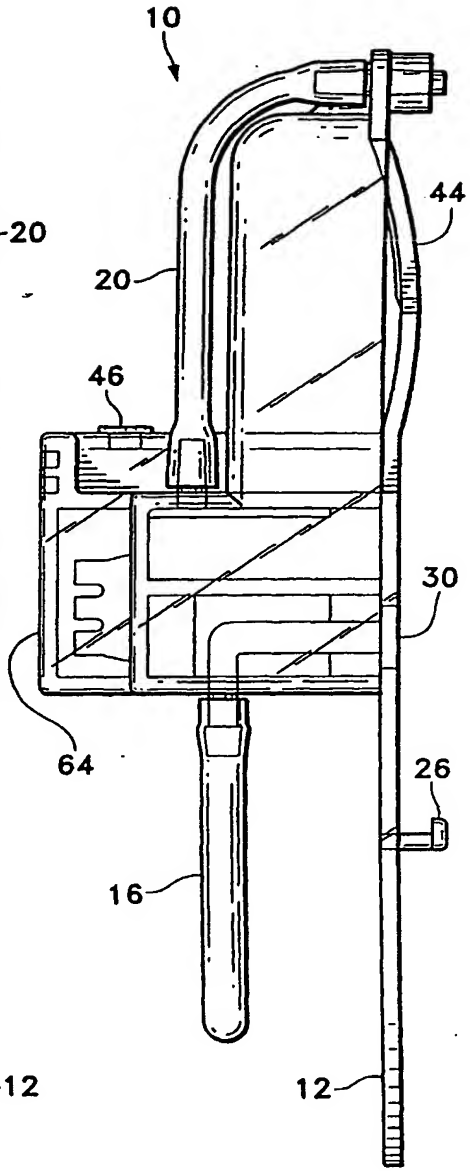

FIG. 4

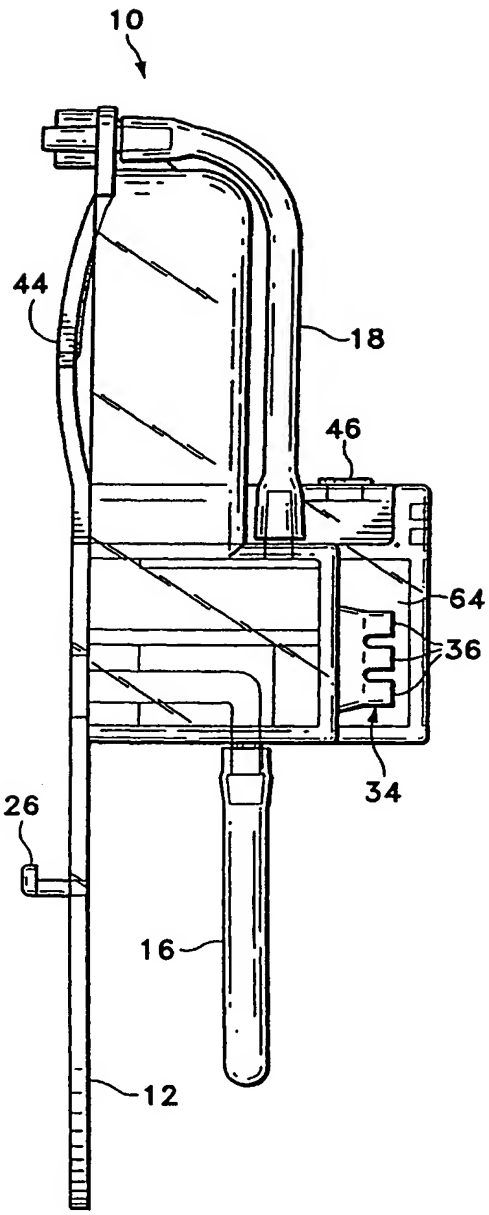

FIG. 5

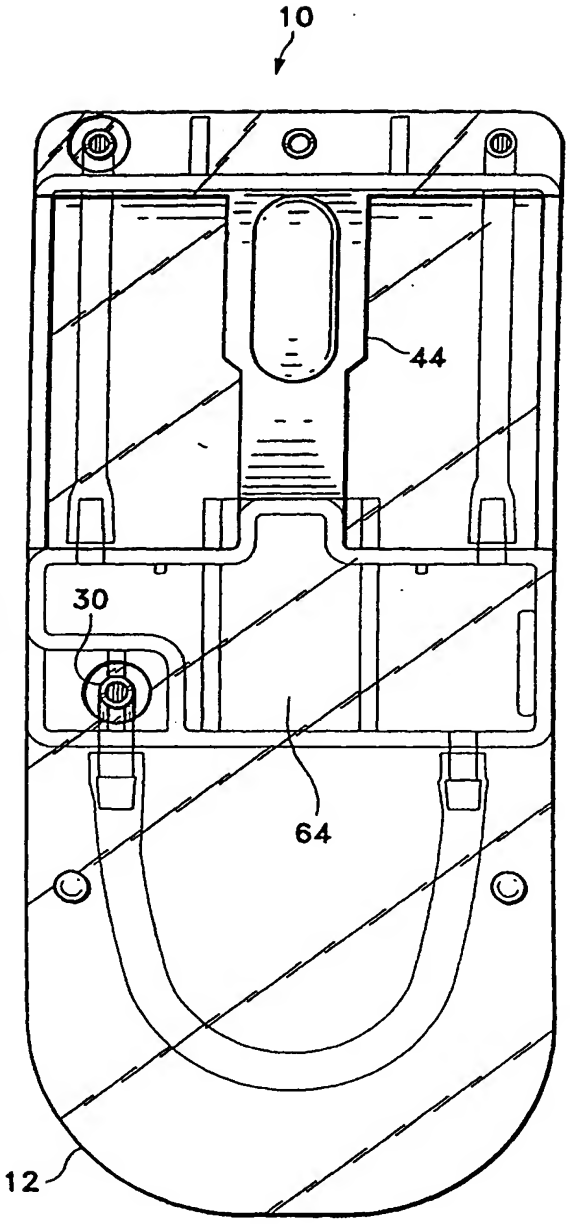

FIG. 6

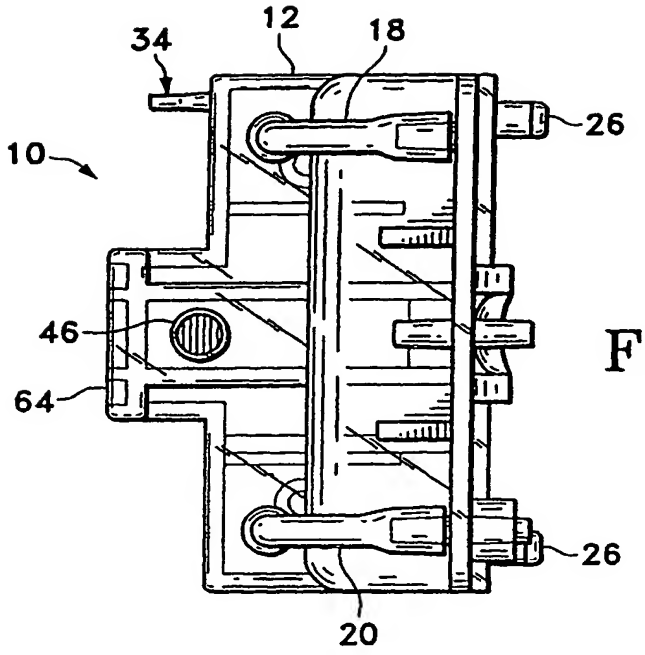

FIG. 7

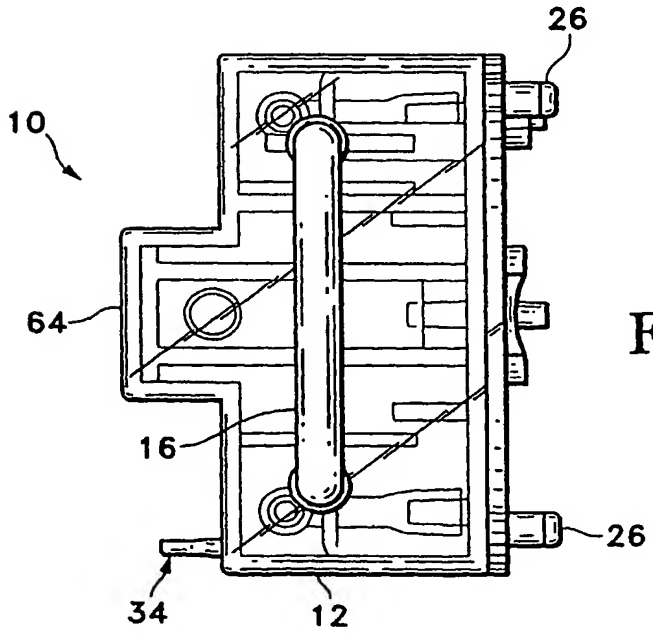

FIG. 8

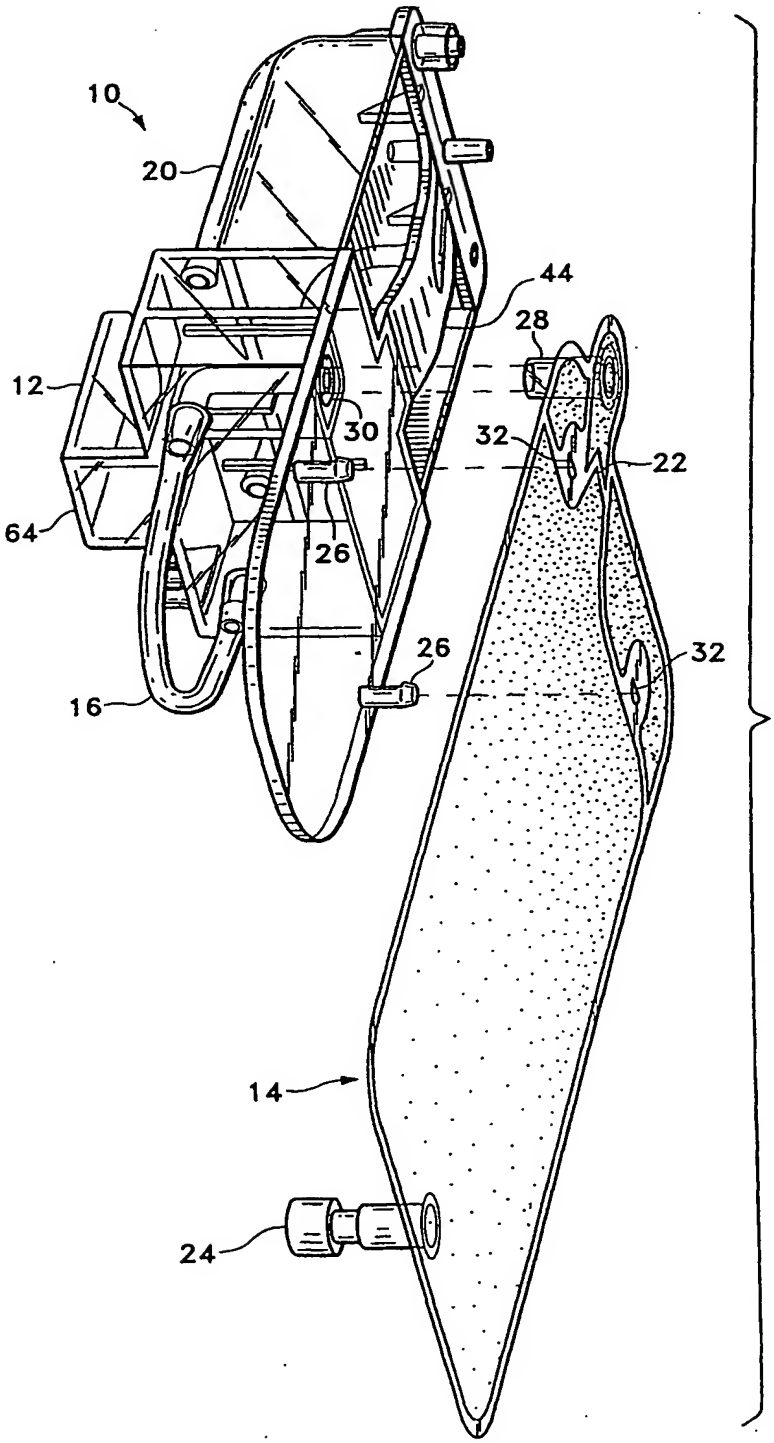

FIG. 9

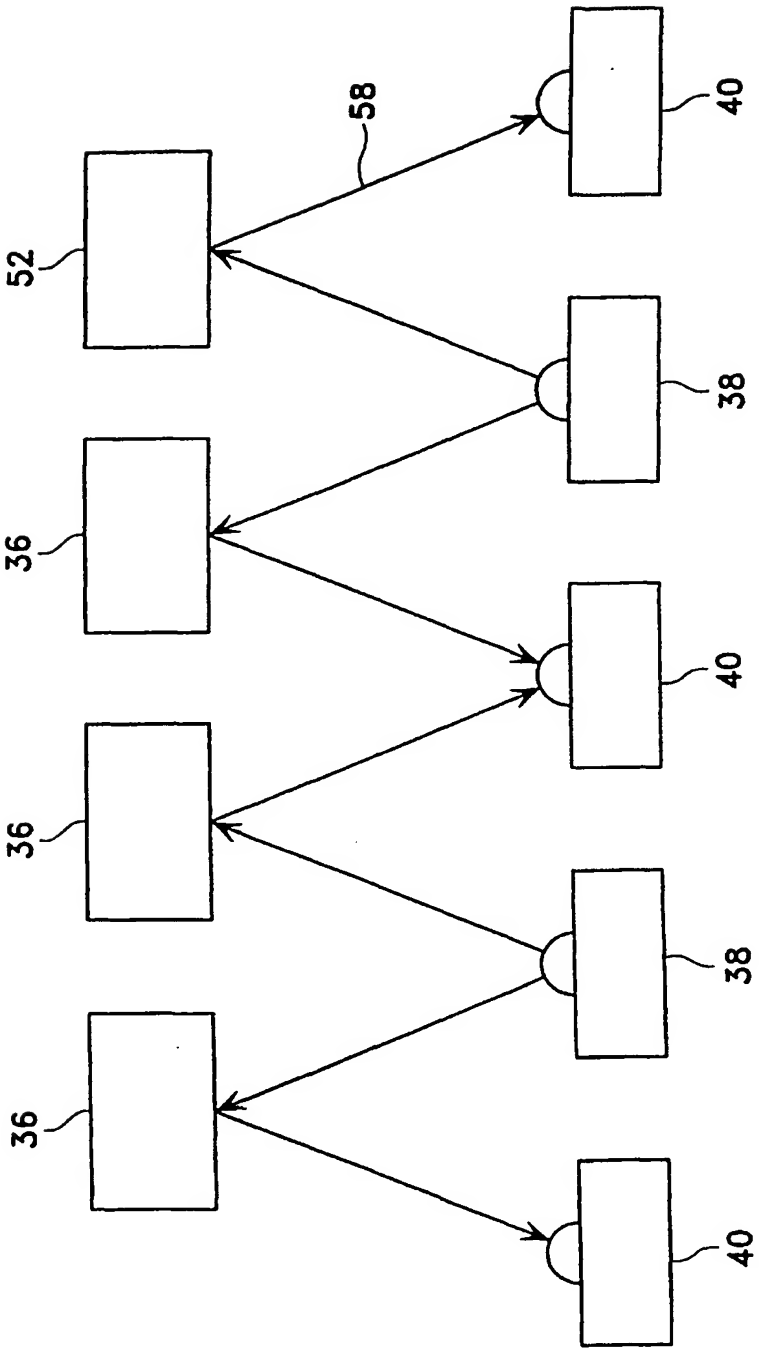

FIG. 10

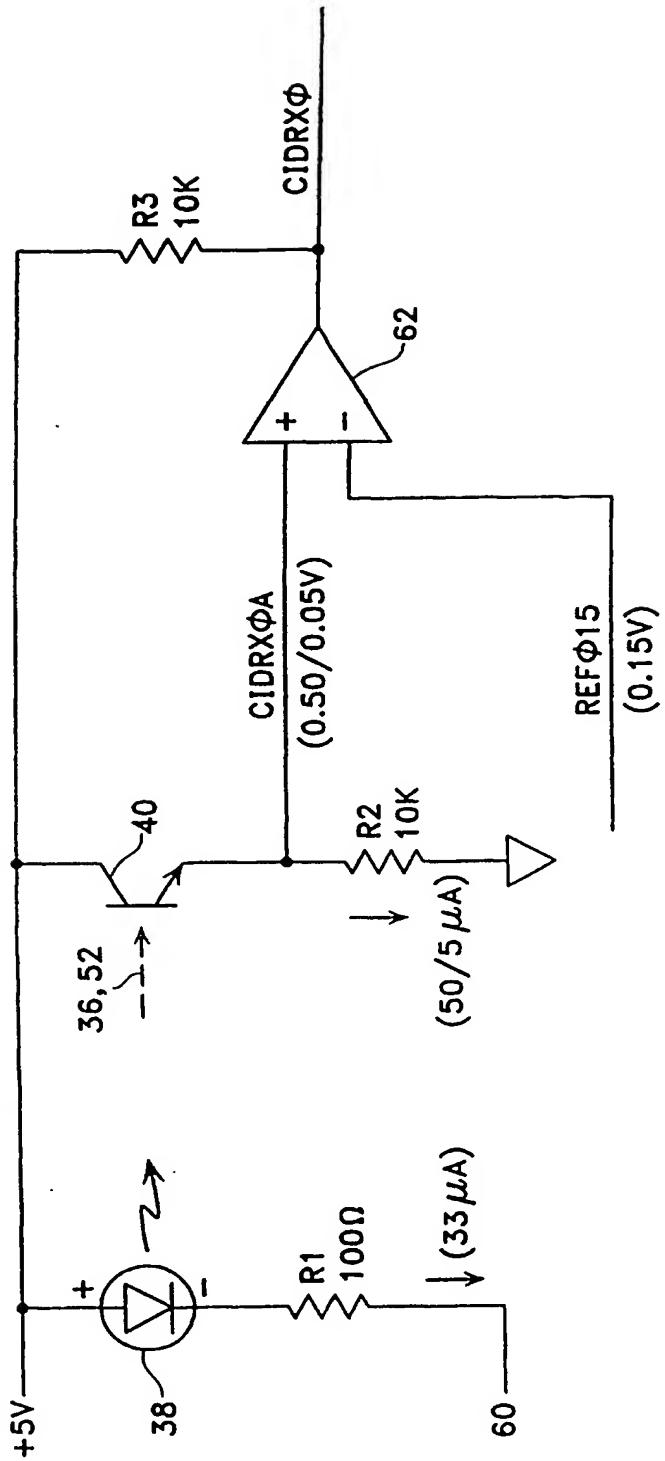
CIDRXΦ
R3
10K
62
+
-
CIDRXΦA
(0.50/0.05V)
REFΦ15
(0.15V)
40
R2
10K
36,52
(50/5 μA)
(33 μA)
R1
100Ω
+
-
+5V
38
60

FIG. 11

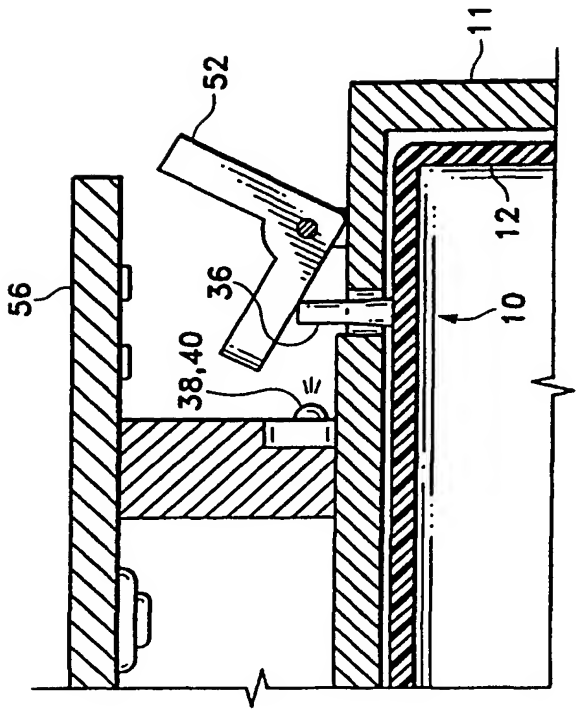

FIG. 13

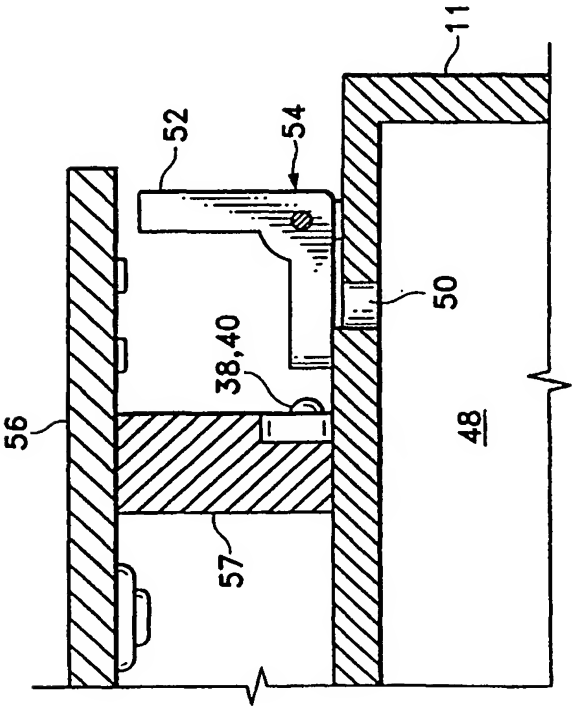

FIG. 12

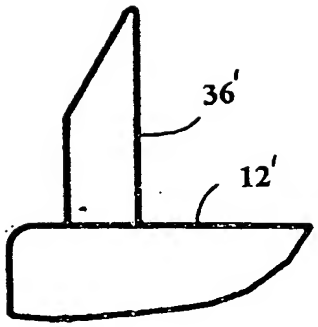

FIG. 14

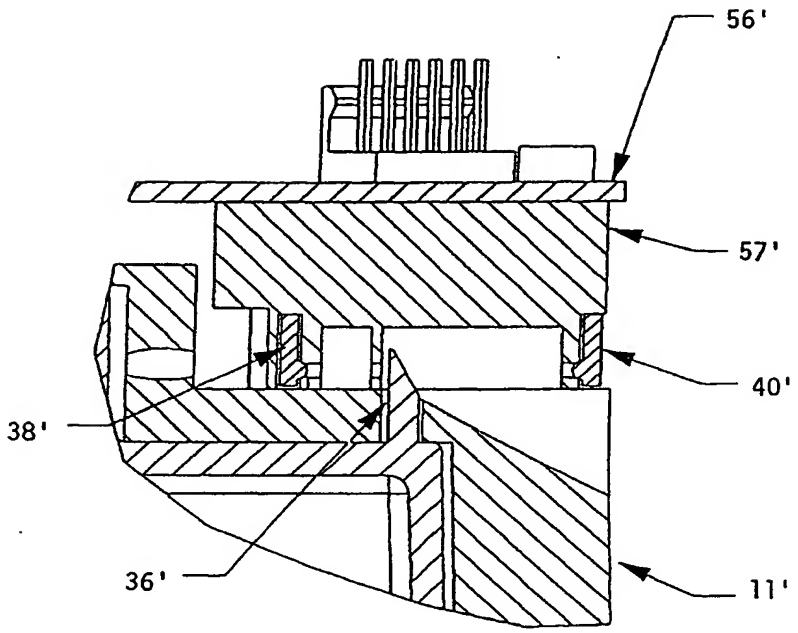

FIG. 15